Citation:

Blum JW, Jacobsen DJ, Donnelly JE. Beverage consumption patterns in elementary school aged children across a two-year period. *J Am Coll Nutr*. 2005 Apr; 24(2): 93-98.

PubMed ID: 15798075

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

- Determine differences in beverage consumption from baseline to year two follow-up in all subjects and based on body mass index (BMI) Z-scores
- Examine the relationship between change in milk consumption and change in sugar-sweetened beverage (SSB) consumption
- Identify predictors of BMI Z-score at year two.

Inclusion Criteria:

Described elsewhere.

Exclusion Criteria:

- Described elsewhere
- Subjects who had outlier values higher than 2.5 standard deviations (SD) on the change in BMI Z-score variable were excluded from the analysis.

Description of Study Protocol:

Recruitment

Described elsewhere.

Design

- Subjects were categorized into four groups based on BMI Z-score at baseline:
  - *Normal weight:* BMI Z-score less than 1.0 at baseline and year two (N=99)
  - *Overweight:* BMI Z-score 1.0 or more at both baseline and year two (N=48)
  - *Gained weight:* BMI Z-score of less than 1. 0 at baseline and a BMI Z-score of 1.0 or

more at year two (N=11)
    - *Lost weight:* BMI Z-score 1.0 or more at baseline and a BMI Z-score of less than1.0 at year two (N=6)
- Using these categories, subjects' beverage consumption patterns were examined in relation to BMI Z-score and predictors of BMI were investigated.

Dietary Intake/Dietary Assessment Methodology

- A 24-hour diet recall was used to determine total caloric intake and beverage consumption at baseline and year two. The 24-hour recall included interviewing the subject two times during the 24-hour period (at noon following the lunch meal and the following morning prior to the start of school)
- Diet recalls represented intakes only on school days. For a random subsample of subjects, parents were called to verify foods and beverages consumed at home during the 24-hour period
- Caloric intake was quantified using the Nutritionist IV diet analysis program.

Statistical Analysis

- Independent T-tests were performed to test for gender differences. No gender differences in consumption of any types of beverage at baseline, year or change from baseline to year two were found; thus results are presented for boys and girls combined
- Paired T-tests were used to determine differences between baseline and year two for milk, 100% juice, diet soda, SSB consumption and total caloric intake in all subjects and each BMI Z-score group
- Repeated measures ANOVA with least significant difference post-hoc tests were used to determine differences among BMI Z-score groups for milk, 100% juice, diet soda, SSB consumption and total caloric intake from baseline to year two
- Pearson product movement correlation was used to determine the relationship between change in milk consumption and change in SSB consumption for all subjects and in BMI Z-score groups
- Regression analysis was used to determine predictors of the BMI Z-score at year two. The first block included BMI Z-score at baseline; the second block included age, gender, age, gender; the third block included baseline consumption of milk, 100% juice, diet soda, sugar sweetened beverages and total calorie intake; and the fourth block included year two consumption of milk, 100% juice, diet soda, SSB and total calorie intake
- Statistical significance was set at $P<0.05$.

Data Collection Summary:

Timing of Measurements

- Data were collected from the fall of 1992 to the spring of 1996
- Dietary data and anthropometric data was collected yearly.

Dependent Variables

- Variable 1: BMI Z-score was calculated by measuring height (to the nearest 0.1cm) and weight (to the nearest 0.1kg), and the EpiInfo Program to calculate age and gender specific Z-scores of BMI
- Subjects were classified as overweight if the BMI Z-score was 1.0 or more and classified as normal weight if the BMI Z-score was less than 1.0.

Independent Variables

- Beverage consumption was measured using a 24-hour recall for a weekday
- All beverages were reported in fluid ounces and were classified as:
  - Milk (skim, 1%, 2%, whole, chocolate, milkshakes)
  - 100% juice
  - Diet soda
  - Sugar-sweetened beverages (regular soda, HI-C, sports drinks, Kool-ade, fruit flavored drinks, ice tea and hot chocolate).

Description of Actual Data Sample:

- *Initial N:* The total eligible sample size was approximately 820 children in grades three through five
- *Attrition (final N):* The longitudinal cohort analyzed for this study was N=166 (92 girls and 74 boys). This included only subjects who were measured at baseline and again two years later
- *Age:* 9.3±1.0 years at baseline; 10.7±0.9 at year two
- *Ethnicity:* 94% of subjects were Caucasian
- *Anthropometrics:* Subject groups were determined by BMI Z-score, and therefore differed by weight status. At baseline and year respectively, BMI Z-scores were:
  - -0.14±0.7 and -0.05±0.7 for normal weight subjects
  - 1.58±0.4 and 1.63±0.4 for overweight subjects
  - 0.65±0.3 and 1.23±0.3 for subjects who gained weight
  - 1.28±0.2 and 0.81±0.2 for subjects who lost weight
- *Location:* United States.

Summary of Results:

- There was no significant (NS) change in 100% juice consumption between baseline and year two in all subjects or any of the BMI Z-score groups; in regression analyses, 100% juice consumption did not account for variance in BMI Z-score
- A significant increase in diet soda consumption from baseline to year two was found for all subjects (0.3±1.8oz to 2.0±5.3oz per day; $P<0.05$), and at year two diet soda consumption in the overweight subjects (3.0±7.0oz per day) and subjects who gained weight (4.7±7.1oz per day) was significantly higher than normal weight subjects (1.2±3.8oz per day)
- Regression analysis indicated that baseline BMI z-score and year two diet soda consumption accounted for 83.1% of the variance in year two BMI Z-score ($R^2=0.83$; $P<0.0001$). Higher baseline BMI Z-score and greater consumption of diet soda at year two were associated with a higher year two BMI Z-score.

Other Findings

- Approximately 60% (N=99) of subjects were normal weight, 29.3% (N=48) were overweight, 6.7% (N=11) gained weight and 3.7% (N=6) lost weight
- Between baseline and year two, all subjects significantly decreased milk intake (19.5±12oz to 16.1±12.0oz per day; $P<0.05$)
- Between baseline and year two, all subjects significantly decreased total calorie intake (1,957.7±575.3kcal per day to 1,831.4±578.8kcal per day; $P<0.05$)

- There were NS change in SSB consumption between baseline and year two in all subjects or any of the BMI Z-score groups; in regression analyses, SSB consumption did not account for variance in BMI Z-score
- A significant inverse association was found between change in milk consumption and change in sweetened-beverage consumption for all subjects.

Author Conclusion:

- The type of beverage consumed over a two-year period among elementary school children changed; milk intake decreased significantly and diet soda consumption increased significantly. Milk also appeared to be displaced by SSBs
- The results showed a positive association between diet soda consumption and BMI; overweight subjects and subjects who gained weight over the two-year study period had significantly higher consumption of diet soda compared to normal weight subjects at year two. For each 12oz serving of diet soda consumption per day, there was a a 0.156 increase in BMI Z-score at year two compared to baseline
- The results do not support an association between SSBs or 100% fruit juice and BMI.

Reviewer Comments:

- *This study is also relevant for questions on calorically-sweetened beverages and dairy and childhood overweight/obesity*
- *In categorizing the subjects by BMI Z-score, the authors include categories for subjects who either gained or lost weight. However, the subjects included in these categories are only those students whose weight gain or loss resulted in a change of weight status from overweight to normal weight or normal to overweight. The authors did not account for weight gain or loss that did not result in a change of weight status. It is unclear how mis-categorizing some subjects who experienced weight gain or loss may have influenced the study results*
- *Dietary intake data was based on only one 24-hour recall that was done on a school day. It is possible that dietary intake on a school day would differ from intake on a non-school day or week. Therefore, it is unclear whether the dietary data used in this study is representative of subjects' usual intake*
- *The authors do not indicate when (i.e., time of year) dietary data and anthropometric data was collected, and whether the data was collected concurrently*
- *The authors conclude that diet soda consumption is positively associated with overweight and weight gain in elementary school-aged children; however, even at year two, all subjects were drinking relatively small of amounts of diet soda (less than 5oz per day on average), making it difficult to determine the real world significance of the findings*
- *The sample size was small and the study used a convenience sample, which limits the generalizability of the study.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	No
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	No
2.2.	Were criteria applied equally to all study groups?	???
2.3.	Were health, demographics, and other characteristics of subjects described?	No
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	???
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	No

3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	No
4.1.	Were follow-up methods described and the same for all groups?	No
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	No
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	No
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes

6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	No
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	No
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	No
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes

9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	???
10.1.	Were sources of funding and investigators' affiliations described?	No
10.2.	Was the study free from apparent conflict of interest?	???